

MARS SOLAR BALLOON/GCMS MISSION

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Abstract

Up to now, the only practical landing system for Mars has been to use a parachute accompanied by a heavy, expensive, retro-rocket landing system that resulted in surface impacts of up to 20 m/second. Useable landed science plus engineering payload mass has been limited to less than 10% of entry mass using this type of landing system. A novel solar balloon/parachute is herein proposed, however, that could dramatically increase the useable total payload mass plus engineering mass to about 50% of entry mass. Use of this type of system would allow a sophisticated gas chromatograph mass spectrometer (GCMS) to be soft-landed on Mars upon initial entry, with the balloon performing imaging, atmospheric measurements, and magnetometry after dropping off the primary GCMS payload.

Hot air balloons, or "Montgolfiere" balloons, are named after the French brothers, Joseph-Michel and Jacques-Etienne Montgolfier, who first flew hot air balloons in the 18th century. A lightweight, solar heated Montgolfiere can be used to slow a martian payload descent to less than 5 m/sec by virtue of both its parachuting capability as well as its dramatic buoyancy effect due to solar heating of the entrained air. Recent tests have already confirmed the ease of altitude deployment and filling of these solar hot air balloons. Furthermore, actual landings and reascents of solar hot air balloons have recently been demonstrated by JPL, and further tests at high altitude are planned in the near future.

The GCMS that is proposed would measure all major constituents of the Mars atmosphere in far greater detail than ever attained before, and should help to provide clear evidence for Mars' past atmospheric history. It may also help determine the source of water we see in the atmosphere now and will search for indications of active chemical processes taking place on Mars today. The GCMS, itself, is an updated version of the type used on Mariner 9, Viking, and various space telescopes.

The post landing mission is proposed to include a high resolution imaging system, atmospheric temperature and pressure measurements, and a magnetometer to search the ancient lava flows for evidence of an ancient Martian magnetic field.

All communication from both the landed GCMS and the balloon gondola will be to an existing orbiter at 128 kbs using a modified DS-2 type of communications system. Total system entry mass is estimated to be 55 kg (with 20% margin), as estimated by JPL's "Team X", and can fit on board the CNES Ariane V piggyback GTO launches.

This mission would not only provide invaluable data on the present and past history of the Mars atmosphere and possible present surface reactions, but it would help demonstrate a radically new, "faster, better, cheaper" landing system that may be capable of landing five times more useable payload than present retro-rocket landing systems.